transparentibus cincti, apicibus bractearum brunneo-lineatis. *Sepala* albotransparentia, 1.5 cm. longa. *Corollae* tubus 6—7 cm. longus, albus; petala acuta, inaequalia; dorsale majus anguste triangulari-ovatum, 1.2 cm. longum: lateralia triangulari-lanceolata, 1.4 cm. longa. *Labellum* 1.5 cm., 0.8 cm. latum, basi album, vix bilobatum sed subrotundatum, apice luteum, in medio linea scalariformi notatum. *Staminodia* alba, 1 cm. longa, obovata, apice rotundata. *Staminis* connectivum crista luteo-tincta, dentibus 2—4 parvis latis coronatum; anthera apices deflexi, granas pollinis extendantes. *Ovarium* 6—8-ovulatum: ovula ex basi orta; stigmatis os despiciens.

Habitat in sylvis montis Bukit kramat kuda, prope Sinolangit, in Sumatra: collegit Mohamed Nur sub numero 7258. Colitur in Horto botanico Singapurense.

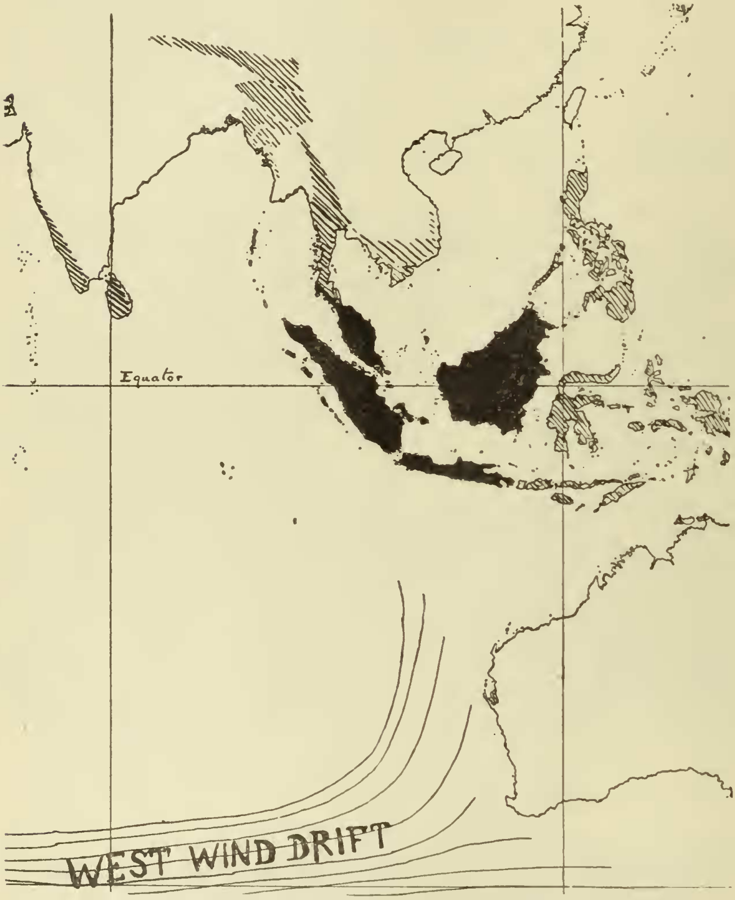
The flowers of this small herb are not conspicuous; they are produced one at a time close to the ground under the leaves, the bases of the lamina of which they scarcely attain. The raceme is not distichous as are the leaves, but shows an arrangement in three stichies. The ovary is sessile among the transparent bracts, and possesses upwards of eight ascending ovules in its single cavity. The corolla-tube is very long and slender, reaching 7 cm., white, and of the same thickness throughout. The petals are not quite equal, the upper which is inclined to arch over being largest while the other two which lie close together are quite behind the labellum. The labellum is large, and only just bifid at the very tip; in the basal half it is white with a brown ladder-like double stripe down the mid-line not extending into the throat, and in the apical portion it is chrome yellow. The staminodes are white. The connective is bent upon the filament at an angle of 45 degrees; it is crested above by reason of four small teeth.

I. H. BURKILL.

A BOTANICAL RECONNAISSANCE UPON THE MAIN RANGE OF THE PENINSULA AT FRASER HILL.

These pages are written under the belief that the following more or less accurately represents the history of the warmth and moisture loving flora of the Malay Archipelago from the Miocene period.

In the Miocene there was a time, or there were times, when very humid conditions prevailed right from the westernmost limits of the Indian Ocean to the Pacific. So long as they prevailed it was possible for plants which can only exist under such conditions, namely the components of a tropical rain forest, to spread through the lands between Africa and the neighbourhood of say New Guinea. But there intruded into this warm and moist climate drier conditions spreading from the west, which on reaching the Arabian Sea cut off that part of the tropical rain forest flora which is now left in the Mascarene Islands, and on reaching the bay of Bengal cut off the tropical rain forest flora of Ceylon and South India; and then impinged upon a rain forest belt extending from Malaysia northwards to the region of the eastern Himalaya, but never so strongly as to break it down. From the dates of the stages of the eastward advance of dry conditions the three rain forest floras, (1) of Mascarenia, (2) of Ceylon and South India, (3) of Malaysia, with Burma, etc. remained isolated, and evolved independently. About the period when the extension of the dry conditions had become complete, it appears probable that the cold West-wind drift (vide map), which surrenders so little moisture



Map showing present position of the west wind drift and cold ocean current, causing dry climate in Western Australia. Western Malaysia is shown black, and other areas of tropical rain forest shaded.

to the winds that blow upon Western Australia, reached the outer shores of Malaysia more distinctly than it does now, and rendered dry their face towards the Indian Ocean in a measure sufficient for an extension of certain dry-climate plants to Australia. During this extension, the rain forest flora would be at bay in the centre of the archipelago. But a recovery from this extreme soon coming, the rain forest flora spread back to the shores of the Indian Ocean, first reaching it where the west wind drift would be weakest, that is to say along the shores of Sumatra, and subsequently following the retreat of the cold current eastward into Java, and onward.

Within the Archipelago complicated orographic changes helped or hindered in various ways the recovery by the tropical rain forest of mastery; and it is for the present generation of naturalists to gather together the geographic and geologic details, which alone can lead to an understanding of the course of events. Much has been written, all of it subject still to criticism, and especially because most of the writers have neglected the possibility of climatic changes, in their effort to explain the peculiarities of the dispersal of living things by land changes: but this is certain, that at present what is here defined as Western Malaysia (see the map) holds the most intense rain forest flora of the old world—a flora which on that account must be considered to have had the least chequered history. It has produced in itself, in a greater measure than any other Old World flora, forests of lofty trees, with an abundance of epiphytes and a wealth of ground plants physiologically fitted to exist in deep and moist shade; and therefore has great claims on the attention of naturalists, because it demonstrates that there has been a nucleus of constant climate within the Malay Archipelago, though not by any means of necessity throughout it.

More than twenty years ago, Dr. O. Stapf called attention to the appearance that Borneo holds as it were a nucleus of the peculiar Malaysian flora. This would happen as a consequence of Borneo holding its least interrupted developments and is understandable upon the theory that the outer shores of the Archipelago were once dried by the greater volume of cold water in that northward branch of the west wind drift current which still affects southeastern Malaysia somewhat.

There are good reasons for thinking that the cold of the Glacial period did not alter the temperatures of the Equator, though greatly compressing the warm temperate and subtropical belts of the Globe. The seas of the Tropics fell, in consequence of the great volumes of water withdrawn and converted into ice caps at the poles, which ice caps again acting through gravity further lowered tropical sea-levels, a condition adding island to island in a region such as Malaysia where the seas are shallow.*

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*The increase of land area is arctic and probably also in antarctic regions during the glacial period would, however, most probably have tended to a decrease of land area in the tropics, this effect counteracting that of the accumulation of ice at the poles (see C. E. P. Brooks, "*Evolution of Climate*", 1922.)

These land unions may be considered as furthering the spread of the rain forest flora after the dry conditions of the outer coast had given way.

In the mountains of southern India and of Ceylon herbs occur of northern genera, and undoubtedly of northern origin. It is possible to believe that the Glacial period gave to most of those in southern India the opportunity which brought them where they are: but as regards those in Ceylon the view which is most acceptable is one which would allow them to have reached the peaks of that island as other plants have undoubtedly reached Oceanic islands, namely by the success now and then of a random shot. And the same supposition is at present the most tenable one for the explanation of the existence of a few truly northern genera (all herbs) upon the mountains of Malaysia. We believe then in a very long continuation of warm and moist conditions within the Malay Archipelago, unbroken over part of it, and that part central, but probably broken at one time on the periphery.

Holding that view, and finding it possible to put a part of it to a test in paying a short visit to some part of the Malay Peninsula we selected for our work the new hill-station of Fraser Hill in Lat. 3° 42′ N. Long. 101° 44′ E. We spent at it the second half of September, 1922, attempting to study the vegetation in the broadest way; and we collected all groups of plants. We were helped in this by Mr. G. S. Neal of the Forest Service, who, with two Malays, was sent most kindly by that Department to assist us. One of us (I.H.B.) has determined the collection of Seed-plants, the other (R.E.H.) has determined the ferns, and is responsible for the naming of the plants of lower position through specialists. We do not in this report enumerate anything below the mosses: but as Mr. H. N. Dixon has most kindly sent his determinations of them, they and their distribution are included. Mr. Ridley's Flora of the Malay Peninsula arrived in the Colony too late for use in the preparation of this report.

We selected Fraser Hill for our work because new roads and paths have made the forest particularly accessible, a new map has fixed the altitudes accurately, and not a little felling has brought the top of the forest within the possibility of investigation. It obviously promised more rapid results than any other place that was open to us.

Fraser Hill occupies the very summit of the Main Range on the Selangor-Pahang boundary. It is not virgin ground, which indeed was an advantage to us, for Mr. C. C. Curtis collected in the neighbourhood, and Mr. H. N. Ridley subsequently visited it twice: the Hon. Mr. C. Hose, Mrs. Ferguson-Davie and Mr. G. E. S. Cubitt also had collected a few plants there between 1919 and our visit; and Mrs. Smith of Bangkok collected ferns in June 1922. Mr. Ridley has described the new species which he got at Fraser Hill as from Sempang mines. These mines, existing as mines no longer, were under a hill whereon a Mr. Fraser built himself a house, and the hill was called Bukit Fraser. When it was decided to develop a hill-station around this house, several other hill-tops being taken into the area, the name Bukit Fraser or Fraser's hill became no longer accurately descriptive: and we have followed the Ordnance Survey's map by calling it instead "Fraser Hill" as if an English township: by this name we mean all the land above 4,000 ft. which has been allotted for development as circumstances permit into a residential place.

The ridges may be described as three, called the North ridge, the South ridge and the Reservoir ridge, the second and the third being parts of the waterparting 4,289 and 4,370 ft. high respectively: the remaining one is entirely on the Pahang side of the division, and reaches 4,286 ft. while South summits on the same side of the waterparting reaches 4,360 ft. A line of vein-quartz extends under parts of the second and third, and while responsible for the resistance to aerial denudation which has made the two ridges, is also responsible for a change in the flora marked enough to carry peculiar species. There is vein-quartz elsewhere, but not so much in evidence, and under the upper end of North ridge appears a thin wall of quartzite.

About Fraser Hill the crests of the Main range are twisted out of the approximate north-and-south line of the range to be nearly east-and-west. That is how Fraser Hill possesses a "north ridge" entirely in Pahang. Westward from Reservoir ridge reaching 4,370 ft., with many serrations, the range attains 4,800 ft. in Pine-tree hill (so misnamed from the Dacrydiums upon it) and bending a little north successively there is the Gunong Semangkok of the maps (5,600 ft.) and the twin peaks of G. Ulu Liang (6,335 and 6.360 ft.) In the other direction the range falls to the Semangkok pass, where the Gap resthouse is situated at 2,790 ft., and rises very abruptly to a Trigonometrical station at 3,883 ft.,* (which appears to be the "G. Semangkok" of Mr. Ridley in his descriptions of plants) and with serrations to G. Ulu Semangkok (4,576 ft.), south of which is G. Ulu Kali (5,812 ft.), and then comes G. Mengkuang lebar, collected over by Mr. H. C. Robinson, the land falling to the Ginting Sempah pass.

We visited Pine-tree hill and a spot a couple of miles short of the Trigonometrical Survey's post on G. Ulu Semangkok.

The drainage from a large part of Fraser Hill runs down a valley toward Tras,—the Tras stream,—and from the immediate neighbourhood of Fraser's house this valley has been much mined for tin. We descended it to 3,300 ft.

It will be found quite clear in the following pages whether we collected the plants we name beyond the limits of Fraser Hill towards Pine-tree hill, or below the 4,000 ft. contour line either towards the Gap or in the upper Tras valley or south-east of the Gap towards G. Ulu Semangkok: and we count no locality below 4,000 ft. as Fraser Hill.

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*For some of the unpublished altitudes we record our best thanks to Mr. V. A. Lowinger, the Surveyor General.

The normal vegetation of Fraser Hill is forest and this we shall describe. A second form of vegetation is that which the steep hill sides, by reason of landslides, maintain: places in the sun being thus afforded to plants of small growth. Man by mining has destroyed the forest not a little, and into the bared places, the landslide vegetation is able to step: but in the wake of man follow many plants which would not seem to be part of the landslide flora: and the mining has been of long enough duration to have given them a good hold. The making of roads of course has exactly the same effect as the mining. These three elements, then, we distinguish on the face of the land,—the forest, on the one hand, and upon the other the landslide plants with the followers of man.

There have been periods in the history of the every part of the globe, when mountain-building was more active in it than now; and these would be periods of steeper slopes and numerous repeated landslides(yet the hill-sides of the Malay Peninsula are still very steep) ; and in such periods there would be a great opportunity for the development of species suited to such a peculiar condition. We are bound to believe that it has occurred; *Calanthe aurea, Rubus rosaefolius, Litsea citrata, Homalanthus populneus* are plants holding their places in the hills by landslides. *Pteridium aquilinum, Histiopteris incisa, Dipteris conjugata, Hypolepis tenuifolia* and probably the Gleichenias are ferns belonging to this group of plants.

The miners of Fraser Hill formerly had but narrow steep paths for their traffic: but now the station is reached by bullock carts and upon the roads one sees the process of introduction of weeds through bullock droppings: thus the droppings lying upon the bare roads carry grasses, notably *Eleusine indica* and in the second degree *Fimbristylis diphylla.* By their absence away from the droppings it is to be concluded that casual seeds of these upon bare landslide surfaces would have but a poor chance of survival.

The forest of the Main range in the Semangkok pass we consider changes at about 3,300 ft. There the Dipterocarps disappear and the depth of the vegetation is reduced from 200 ft. to 100 ft. Close to the elevation at which the Dipterocarps vanish, Arenga disappears, and Pandanus also. Upon the ridges above 4,000 ft. the big trees are about 100 ft. high. We roughly measured eighty-two on the North, South and Reservoir ridges, as given in the following table, taping the bole at breast height, but judging the other dimensions by eye with the help of a rod laid against the lower part of the bole. We measured all trees in the selected places that appeared to be upwards of five feet in girth, our malay assistants naming them: and we consider that we obtained the height of the forest in this way with a fair measure of accuracy. All measurements are expressed in feet.

TABLE I.

The Size of Trees at Fraser Hill.

Malay name and probable genus	No. of trees	limit of girth	limit of bole	limit of total height	limit of spread of longest branch
Kadondong (*Canarium*)	31	4.5-11.5	35-75	65-105	15-40
Nyatoh (*Payena*)	11	4.5-13	25-65	65-100	15-20
Mempuning (*Quercus*)	7	4.5-8	45-70	75-100	15-30
Kelat (*Eugenia*)	9	4.5-6.5	35-70	60-90	15-30
Rengas (*Gluta*)	5	5-10	40-60	80-100	15-25
Bintangor (*Calophyllum*)	2	5-6	65-70	85-90	20
Meragu	2	4-8	40-45	75-85	20-30
Medang (? *Phoebe*)	2	4.5-5	55-65	80-85	15-20
Penaga betul (*Calophyllum*)	1	8	55	85	30
Samok (*Eugenia*)	1	6.5	40	65	40
Ludai	1	6	20	85	20
Kadondong mata-hari (? *Trigonochlamys*)	1	5.5	25	70	20
Plangi	1	5.5	60	95	20
Kulim burong	1	5.5	60	85	25
Kayu kuning	1	5.5	60	80	20
Tampoi (? *Baccaurea*)	1	5	45	85	30
Kumala	1	4.5	60	90	35
Pelit	1	4.5	55	70	15
Pulangdaing	1	4.5	30	80	20
Kunkur	1	3.5	70	80	10
Putat (*Barringtonia*)	1	3.5	60	80	20

It is a very noteworthy fact that the big trees are upon the tops of the ridges; down their slopes, while there are more trees to the acre than above, on the average they are smaller. Though not quite certain of the cause of this, we believe that it is a consequence of horizontal light passing under the crowns and making the conditions easier for the lesser growth, which so favoured in the air handicaps in the soil the competitors which might become of larger growth.

From the eighty to one-hundred feet high forest of Fraser Hill, if we ascend, as we do in the direction of Pine-tree hill, we get into forest fifty feet high, and then into forest twenty-feet high. Doubtless on G. Ulu Liang at the height of a further thousand feet, this reduction in depth would bring us to the real Elfin forest of our highest mountains: but we did not approach it at all. The vegetation of the summit of Pine-tree hill is of trees of Dacrydium Beccarii about twenty feet high, and of Rhododendrons and Vacciniums not taller.

Before passing on from the matter of the depth of the forest, it may be said that by means of Negretti and Zambra's dendrometer we measured some of the lofty trees at 3,300 ft. and below and found a lofty Shorea with a bole of 17 ft. in girth to reach 200 ft.

The tall forest, of course, holds more than one height of tree. On slopes it is not layered, but on the tops of the ridges the big trees with crowns 20-40 feet across (see the table above) shut out light enough to make it necessary for light-diffusion spaces to exist, whereunder a new layer of foliage can develop. The forest that is 50 feet high exhibits no layers.

About Fraser Hill there is no mossy forest: it is necessary to ascend higher for it. One of us spent a week in May, 1922, on G. Gedeh in Java at 4,500 feet, finding the climate there, height for height, colder and the forest more mossy. It is very probable that the air currents which sweep down the sides of G. Gedeh from anything up to 9,000 feet account for this: and there are no heights over Fraser Hill to supply cold down-draughts. The higher mountains further north were frequently observed to be covered with cloud when Fraser Hill was free from it (G. Ulu Liang is reputed to be very wet) and this more constant saturation of the atmosphere is no doubt necessary for the maintenance of mossy forest. However, the more one ascends from the height of Fraser Hill in the direction of Pine-tree hill, the more mossy becomes the forest and the deeper the layer of raw spongy humus upon it, until the latter is eighteen inches thick. In this mossy layer *Calanthe angustifolia, Burmannia longifolia, Sonerila rudis, S. velutina, Argostemma Yappii* find themselves particularly at home.

Pine-tree hill is about 4,800 feet high. It is evident that a flora of another type replaces the typical Fraser Hill forest there, and this one observation suggests that the type of vegetation which we have said commenced about 3,300 feet, gives way about 4,800 feet. The conclusion wants confirmation. In this replacing vegetation, because the trees are of lesser size than at lower levels, except for the interference of cloud, more sunlight is able to reach the ground. The vegetation which uses this sunlight is only in a small measure of phanerogamic herbs, apparently because of the acidity of the mossy raw humus on the surface of the soil.

There is no light-diffusion space in the mossy forest, and the small trees are very crowded. Upon the tops of the ridges of Fraser Hill there is however a somewhat imperfect light-diffusion space with the branches of the trees above it and with small to four feet high plants below it such as: *Polygala venenosa, Pterisanthes pulchra, Blastus cogniauxii, Sonerila rudis, S. albiflora, S. integrifolia, Phyllagathis hispida, Begonia tricornis, Begonia sp., Argostemma Yappii, A. urticaefolium, A. spinulosum, A. involucratum, Gardenia pulchella, Chasalia rostrata, C. lurida, Cephaelis* 2 spp., *Pentaphragma Scortechinii, Labisia pumila, L. longistyla, Ardisia Maingayi, Didymocarpus flavescens, D. hirta, D. malayana, D. platypus, D. quinquevulnera, D. crinita, D. venusta, D. pumila, Strobilanthes hirtisepalus, Filetia hirta, F. paniculata, Justicia subalternans, Gomphostemma* sp., *Piper stylosum, P. semangkoanum, C. brachystachys, Balanophora multibracteata, Burmannia longifolia, Liparis* sp., *Calanthe angustifolia, Anoectochilus Reinwardtii, Anoectochilus* sp., *Cryptostylis arachnites, Globba aurantiaca, G. cernua, Camptandra ovata, Zingiber spectabile, Zingiber gracile, Zingiber Griffithii, Alpinia petiolata, Geostachys secunda, Curculigo latifolia, Tacca cristata, Pinanga polymorpha, Pinanga paradoxa, Licuala pusilla, Forrestia gracilis, Arisaema Scortechinii, Amorphophallus* sp., *A. Lowii, Lephatherum gracile, Lindsaya orbiculata, L. decomposita, Trichomanes rigida, T. pluma, Diplazium bantamense, D. sylvaticum, D. tomentosum, D. fraxinifolium, Asplenium tenerum, Dryopteris crassifolia, D. calcarata, D. parasitica, Phegopteris laserpitiifolia, Taenitis blechnoides, Cheiropleuria bicuspis, Selaginella atroviridis, S. Wallichii.*

Equally under dense shade, but requiring running water, or an unusual amount of it, with good soil, are: *Impatiens oncidioides, Ophiorrhiza erubescens, Cyrtandra pilosa, Phaius callosus, Alocasia Beccarii* and *Schismatoglottis* sp.

This assemblage of small plants contains a very large percentage of seed-plants with a restricted distribution. Of the 70, 44 or 63 per cent. are confined to the Malay Peninsula and a further 13, making in all 57, or 84 per cent. do not pass out of what is here called western Malaysia. This is a greater percentage of endemism than in the overshadowing trees and shrubs, but not greater than among epiphytes, nor among giant herbs.

The overshadowing trees and shrubs number 105 and of them 60, or 57 per cent. are confined to the Malay Peninsula, and another 26, making in all 83, or 82 per cent. do not extend beyond western Malaysia.

The climbers which climb these forest trees are 28 in number, and of them 12, or 43 per cent, are endemic, while a further 10, or 22 in all, making 79 per cent, do not pass beyond western Malaysia. The figures will be found in Table II.

The wide-spread seed-plants of the forest-floor flora are: *Chasalia lurida, Chloranthus brachystachys, Crypstostylis arachnites, Panicum indicum* and *Lephatherum gracile*,—plants which do what no epiphyte does, namely spread from Ceylon to Malaysia, but with a broken distribution in almost every case.

The following are the Fraser Hill species which have an extension from western Malaysia into eastern Malaysia in varying degrees, without extending into Australia nor into the Pacific:

(forestal species)

Anoectochilus Reinwardtii reaches Amboina; *Memecylon myrsinoides* reaches Celebes; *Polygala venenosa, Xanthophyllum excelsum, Urophyllum glabrum, Quercus cyrtorrhyncha, Engelhardtia spicata, Dacrydium falciforme, Liparis compressa,* and *Eria major* reach the Philippines: and *Burmannia longifolia* reaches New Guinea;

(species of the open)

Joinvillea borneensis reaches Palawan only, and *Spathoglottis aurea* reaches Celebes. *Spathoglottis plicata* and *Gahnia javanica* from western Malaysia reach Samoa and Fiji respectively.

The following species occur in Tenasserim or the Andamans and thence south and east into Malaysia but in no case through it to Australia, nor into the Pacific:

(forestal plants)

Limacia triandra, Leptonychia heteroclita, Schima Noronhae, Adinandra dumosa, Vitis mollissima, Arthrophyllum diversifolium, Rhodamnia trinervia. Elytranthe formosa. Eria floribunda. Curculigo latifolia. Tacca cristata and *Anadendron montanum.*

(plants of the open)

Elaeocarpus gambir, Daphne composita and *Glochidion coronatum.*

There are a few interesting plants with a distribution in the direction of Indo-China and China. They are (1) reaching Indo-china *Illicium cambodianum, Labisia pumila,* and *Dacrydium elatum*: and (2) reaching China, *Gynura bicolor* and *Smilax laevis.*

The following have an extension of range northward to the eastern Himalaya: (all forestal, except *Jussieua, Pratia* and *Blumea*) *Jussieua fissendrocarpa, Randia racemosa, Ophiorrhiza erubescens, Blumea balsamifera, Pratia begonifolia, Ardisia colorata, Loranthus pentapetalus, L. coccineus, Elytranthe globosa, Conocephalus suaveolens, Ficus rostrata, Podocarpus neriifolius.* Out of these *Randia* extends to Australia, the *Podocarpus* to New Guinea; *Loranthus pentapetalus* and *Conocephalus suaveolens* to the Philippine Islands; the others not passing beyond western Malaysia in an eastward direction.

The following occur in Ceylon or Southern India and two reach the Seychelle islands:—

(forestal)

Melastoma malabathricum Eugenia zeylanica, Psychotria sarmentosa, Chasalia lurida, Vernonia arborea, Gaertnera Koenigii, Uncaria dasyoneura, Chloranthus brachystachys, Cryptostylis arachnites, Panicum indicum, Lophatherum gracile

(of open places)

Vitis trifolia, Pithecolobium angulatum, Drymaria cordata, Rubus rosaefolius, Trichosanthes bractescens, Embelia Ribes, Polygonum chinense, Litsea citrata, Homalanthus populneus (doubtful), *Trema orientalis.*

Of these two reach Australia, four eastern Malaysia, and the other two do not pass beyond western Malaysia.

Of the ferns nearly 50% reach Ceylon and nearly 20% reach the Mascarenes.

There remain 19 pantropic plants and everyone of them is a plant of the open. All of them are foreign to the flora of Fraser Hill, being intruders following man: and it will scarcely be necessary in this place to name them. Fourteen ferns are pantropical, six of these being plants of the open.

It is convenient to name here, before passing on, the few plants which we found above Fraser Hill and not at it: they are, *Polyalthia pulchra* which is endemic, an *Eugenia* which appears to be endemic, *Sonerila tenuifolia*, which occurs in Sumatra, Java and Borneo, *S. velutina, Webera salicina* and *Pentapterygium Scortchinii*, all three being endemic, *Diplycosia latifolia* which occurs in Sumatra, a *Diplycosia* and *Dischidia albida,* which are endemic, an *Antidesma* unmatched and possibly endemic, *Dacrydium Beccarii* which occurs in Borneo and in Mindoro, and lastly *Agrostophyllum bicuspidatum,* an orchid whose absence at Fraser Hill is improbable as it occurs from Tenasserim through the Peninsula to Java and to Celebes. Eight out of twelve are endemic species. Three of them are genuine xerophytes, *i.e. Dacrydium Beccarii* and the two species of *Diplycosia.*

The next statement gives the distribution, as known, of those species which are confined to western Malaysia, but not endemic in the Peninsula:—

reaching Lingga only, 1 species,
reaching Bancka only, 1 species,
reaching Sumatra only, 13 species,
reaching Borneo only, 11 species,
reaching Java only, 7 species,
reaching Java and Sumatra, 8 species,
reaching Borneo and Sumatra, 11 species,
reaching Borneo and Java, 5 species.
reaching Sumatra, Java and Borneo, 14 species;

this makes 46 as common to the Peninsula and Sumatra, 36 as common to the Peninsula and Borneo; and 34 common to the

Peninsula and Java: but it is certain that as Sumatra and Borneo become better known the number of plants common to either of them and to the Peninsula, will increase and greatly out-distance the number that are common to Java and the Peninsula.

Table II.

Distribution of Species.

	Confined within the Peninsula.	Extending to Islands of Western Malaysia.	Extending to the Pacific.	Extending to Tenasserim and the Pacific.	Extending to the Himalaya, China and the Pacific.	Extending to Ceylon or Mascarenia and the Pacific.	Without bounds in the tropics.	TOTAL.
Forest Plants.								
1. *Numbers of species*								
Shading trees and shrubs	60	26	6	5	4	4	..	105
Climbers	12	10	..	2	2	2	..	28
Overhead parasites	2	2	..	1	3	..	..	8
Epiphytes	36	17	1	2	..	..	..	56
Giant herbs	2	1	..	..	..	..	..	3
Plants of the forest floor	44	13	4	2	2	5	..	70
Ground ferns	2	4	4	..	7	12	3	32
Epiphytic ferns	3	4	14	..	5	17	5	48
2. *Percentages*								
Shading trees and shrubs	57	25	6	5	4	4	..	..
Climbers	43	36	..	7	7	7	..	..
Overhead parasites	25	25	..	13	37	..	..	..
Epiphytes	64	30	2	4	..	..	..	..
Giant herbs	67	33	..	..	..	..	..	..
Plants of the forest floor	63	18	6	3	3	7	..	..
Ground ferns	6	13	12	..	22	38	9	..
Epiphytic ferns	6	9	29	..	10	36	10	..
Plants of the Open.								
Trees and shrubs	2	3	..	3	1	3	..	12
Climbers	1	3	..	..	..	4	..	8
Herbs	1	..	4	2	4	1	19	31
Ferns	2	..	..	..	2	3	6	13

In the notes below some trouble has been taken to show how species montane in the north of the Peninsula descend more or less to sea level in the south. This we attribute to the distinct intercalation of a dry period in the north, and its disappearance. all but complete, southwards.

Of the plants which extend from the Peninsula into other parts of western Malaysia, without going further, two thirds descend to low levels. On the other hand very few of the Fraser Hill species which are endemic in the Peninsula descend to low levels. It is as if to have been able to pass between the Peninsula and other parts of western Malaysia, the forestal species with which we are dealing had to possess the ability to live in a climate as of Johore and Singapore at sea level.

A land connection between the Peninsula and Sumatra and another between the Peninsula and Borneo, in past ages, are admitted generally to have existed. It would seem right in general to believe that those land connections, at any rate on the last occasion of their existence, were low, having at the same time the climate of the south of the Peninsula: it is not necessary to place them as geologically remote, and it is possible to believe that while they (or the last of them if they were repeated) existed, our possibly already considerably evolved montane forestal flora retained its isolation in our mountains undisturbed, evolving locally its endemic species.

It is easiest to believe that the dry climate flora which seems to have passed down the coasts toward the Indian Ocean, did so earlier, and that the spread of these moisture loving plants into Java from Sumatra was subsequent.

Mention has been made of the occurrence of quartz in veins about Fraser Hill. This rock by its very slow decomposition makes the poorest of soils: and the vegetation on them is characteristic. In the first place *Dacrydium falciforme* is a most abundant tree. Its chief associates are Eugenias, one of which is *E. zeylanica*. Other trees which were found with it upon this soil are:—
Illicium cambodianum, a curious *Anonacea*, *Weinmannia Blumei* *Pygeum ovalifolium*, *Timonius* sp. *Lindera Wrayii*, *Elaeocarpus paniculatus*, *E. apiculatus*, *E. reticulatus*, *Vaccinium bancanum*, *Rhodamnia uniflora*, *Cinnamomum aureofulvum* and *C. rhynchophyllum*, *Evodia pachyphylla*, *Ilex* sp. *Melastoma malabathricum*, var. *perakense*, *Ardisia chrysophyllifolia* and *A. retinervia*, *Eugenia oreophila*, *Arthropanax pinnatum*, *Memecylon myrsinoides*, *Anorincleistus grandiflora*, *Wikstroemia Candolleana*, *Litsea* sp. *Rubus glomeratus*, *Vitis trifolia*, *Gynochthodes sublanceolata*, *Gaertnera Koenigii*, *Chasalia curviflora*, *Psychotria sarmentosa*, *Uncaria dasyoneura*, *Dioscorea laurifolia*, *Smilax laevis*, *Nepenthes sanguinea*, *Alyxia pumila*, *Pterisanthes pulchra*, *Scindapsus Scortechinii*, *Cyrtandromaea megaphylla*, *Argostemma Yappii*, *Didymocarpus hirta* *D. pumila*, *Pteridium aquilinum*, *Ceropteris calomelanos*, *Alsophila kingii*, *Hypolepis tenuifolia*, *Histiopteris incisa*.

Of the seed plants in this list 24 are endemic; 10 reach other parts of Western Malaysia; two pass just outside, one to Celebes the other to Mindoro; and the rest are much more widespread; *Melastoma malabathricum* reaching the Seychelles, *Eugenia zeylanica*, *Uncaria dasyoneura*, *Psychotria sarmentosa*, *Chasalia lurida*, and *Gaertnera Koenigii* reaching Ceylon, *Vitis trifolia* reaching Himalaya, *Similax laevis* reaching China, and *Illicum cambodianum* reaching French Inlo-China.

The percentage of endemism is about 55 or not different from that found in the forest of Fraser Hill taken as a whole.

Summary. When a traveller ascends from the Semangkok pass to Fraser Hill, he passes at about 3300 feet out of a very lotfy forest into one of lesser growth—its tall trees being 80-100 feet high at Fraser Hill. At a little distance from Fraser Hill where the range runs higher, about say 4700 feet, another type of forest appears, being of lesser growth and more mossy. The forest which we have studied especially is a part of that between 3300 and 4700 feet, namely that at Fraser Hill itself between 4000 and 4370 feet. Of its woody shading plants 57% are confined to the Peninsula, of its epiphytes 64% and of its ground vegetation (seed plants) 63%. These are high percentages, and indicate a considerable isolation of the mountains of the Peninsula. The species of the forest which are not endemic exist for the most part as lowland plants in the south of the Peninsula: by doing which they suggest that when the Peninsula was joined by land to Sumatra or to Borneo the land bridge was in climate and want of elevation as Johore and Singapore. It is clear that the montane species did not cross it. These montane species were evolved locally from typically Malaysian genera, and do not declare themselves immigrants evolved elsewhere. All their genera except *Daphne*, *Geostachys*, and *Nenga* are known from Borneo and all except *Leptorrhyncha*, *Blastus*, *Anerincleistus*, *Phyllagathis*, *Filitia*, *Dacrydium*, *Agathis* (introduced however) *Camptandra*, *Geostachys* and *Joinvillea* are known from Java: whereas as many as 60 of the genera are absent from Ceylon.

We recognise as present another flora—the flora that requires open ground. It is small and of mixed origin, for there are in it species whose genesis would seem to be upon ground bared by landslides, and there are intruders following man. The flora is rather small for analysis though very interesting.

PART II.

Enumeration of the Seed-Plants, Ferns and Mosses Collected.

In this enumeration the literature cited is the last only which sums up in any way the distribution of the plants in various parts of Western Malaysia.